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(71) Anmelder *(für alle Bestimmungsstaaten mit Ausnahme von US)*: STOCKHAUSEN GMBH & CO. KG [DE/DE]; Bäkerpfad 25, 47805 Krefeld (DE).

(72) Erfinder; und
(75) Erfinder/Anmelder *(nur für US)*: SMITH, Scott [US/US]; 4100 Duplin Court, Greensboro, NC 27407 (US). FRANK, Markus [DE/DE]; Kornstr. 72a, 47918 Tönisvorst (DE).

(74) Anwalt: HERZOG, Martin; KAHLHÖFER NEUMANN HERZOG FIESSER, Karlstrasse 76, 40210 Düsseldorf (DE).

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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(54) Title: ABSORBENT HYGIENE ARTICLE PROVIDED WITH A WET INDICATOR

(54) Bezeichnung: ABSORBIERENDE HYGIENEARTIKEL MIT EINNÄSS-INDIKATOR

(57) Abstract: The invention relates to an absorbent hygiene article comprising: (a) a stiff element that stiffens when brought into contact with body fluids or; (b) a gas element that forms a gas when brought into contact with body fluids or contains both as an indicator, and; (c) at least one hygiene article component, whereby the stiff element or the gas-forming gas element or both of these elements are in contact with the hygiene article component.

(57) Zusammenfassung: Die vorliegende Erfindung betrifft einen absorbierenden Hygieneartikel, aufweisend (a) ein sich im Kontakt mit Körperflüssigkeiten versteifendes Steif-Element oder (b) ein im Kontakt mit Körperflüssigkeiten ein Gas bildendendes Gaselement, oder beide als ein Indikator und (c) mindestens eine Hygieneartikelkomponente, wobei das Steif-Element oder das Gas bildende Gaselement oder beide mit der Hygieneartikelkomponente in Kontakt stehen.

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ABSORBENT HYGIENE ARTICLE PROVIDED WITH A WET INDICATOR

The invention concerns an absorbent hygiene article, a process for producing it and also the use of this hygiene article to control a wearer's inclination to urinate or as a urination indicator.

Diapers are available in different sizes and with different absorption capacities depending on the age of the wearer, especially the age of the baby. Owing to the considerable wear comfort of current diapers and their absorption performance, children generally become toilet trained later than just some years ago. For a child undergoing toilet training or toilet teaching it is advantageous for the child to recognize when urination has occurred.

Specific diapers or diaper pants have been developed in this connection for toddlers that utilize various devices to indicate to the child and to the mother or to both that the child has urinated into the diaper and the diaper thus has to be changed.

There are various prior art proposals in this connection. WO 00/00232 has an electronic sensor being utilized to indicate urination. WO 97/10789 discloses an indicator which utilizes capillary forces to generate a visual signal to the wearer. US 5,468,236 discloses an indicator which utilizes chemical means to generate a visual signal.

These measures disclosed in the above-cited references

enable not only the child but also the mother to take notice of urination significantly earlier than would be the case with customary diapers without such indicators. However, the aforementioned measures have the disadvantage that urination is signalled to mother and child at the same time. This does not lead to increased independence on the part of the child. On the contrary, the diaper will generally be changed because of perception on the part of the mother. Yet for the child to approach its mother of its own volition with a wish that the diaper be changed would constitute a substantial reward effect, which would result in earlier independence on the part of the child.

WO 96/19168 discloses diapers which comprise means whereby the diaper wearer can sense a temperature change, moisture or else a deformation in the diaper. The temperature change is made possible through certain substances which react to contact with an aqueous fluid by releasing or else absorbing heat, whereas a moisture sensation is made possible through specific diaper layers which retain moisture. Diaper deformation is achieved through incorporation in the diaper body of specific materials, such as cellulose sponges for example, which then swell up on contact with an aqueous fluid. However, the disadvantage of these cellulose sponges consists in their limited ability to swell and also in the high manufacturing costs of these materials.

The invention accordingly has for its general object to

overcome prior art disadvantages. More particularly, it is an object of the present invention to provide a hygiene article having a urination indicator which signals to the wearer without perception on the part of the surroundings of the wearer before the wearer that urination into the hygiene article has occurred. However, this indication should take place at least without significant impairment to the other performance features of the hygiene article. Furthermore, this urination indicator shall be based on cost-effective materials.

The present invention's object is achieved by an absorbent hygiene article comprising

(a) a stiffening element which stiffens in contact with body fluids

or

(b) a gas element which forms a gas in contact with body fluids,

or both as an indicator

and

(c) at least one hygiene article component,

wherein the stiffening element or the gas-forming gas element or both are in contact with the hygiene article component.

According to the invention, it is preferred that the stiffening element reduce the flexibility of the hygiene article. Preferably, the flexibility is reduced to such an extent that the wearer finds it markedly more difficult to move while wearing the hygiene article. But flexibility should not be

reduced to such an extent that the wearer becomes very difficult to move or even immobile.

According to the invention it is further preferred that the stiffening element be a resin which stiffens in contact with body fluids or an inorganic compound which stiffens in contact with body fluids or both.

Preferably, the gas element forms a gas which is generally recognized as safe. It is further preferred that the gas element form this gas in such amounts that these, although noticeable to the wearer and, similarly to the reduction in flexibility, reduce the wear comfort of the hygiene article, do not, however, lead to any painful sensation on the part of the wearer.

Body fluids in the context of the present invention refers to sera, blood and urine, preferably urine, which derive from the wearer of the present invention's hygiene article.

According to the invention, the preferred stiffening resin is a polyurethane-comprising resin as described for example in US 4,774,937, which forms part of the disclosure of this application. Stiffening inorganic compounds which are preferred according to the invention are gypsum or gypsum-comprising systems. Among gypsum-comprising systems, preference is given in particular to those which are employed as bandaging material, for example to set bone fractures in orthopedics. The gypsum-comprising systems are preferably characterized in that gypsum compounds have been taken up in a matrix. The matrix is

preferably a fibrous laid, formed-loop knit or woven fabric, woven fabrics being particularly preferred. The gypsum fraction in the gypsum-comprising system is preferably at least 10%, more preferably at least 30% and even more preferably at least 50% by weight, based on the system. In a particular embodiment of the present invention's absorbent hygiene article, the latter comprises a gypsum-comprising system, the system comprising gypsum in an amount in a range between 35% and 70% by weight.

According to the invention it is preferred that the gas-forming gas element form CO_2 or N_2, the formation of CO_2 being preferred. In general, all CO_2-forming chemical compounds known to one skilled in the art come into consideration, particular preference thereamong being given to carbonates and bicarbonates of alkali or alkaline earth metals. Preference among these is in turn given to sodium bicarbonate, potassium bicarbonate, magnesium bicarbonate, calcium bicarbonate, and sodium bicarbonate is particularly preferred. The aforementioned compounds are preferably used together with an acid in such an amount that the pH on contact of this mixture of CO_2-forming compound and acid with an aqueous fluid is in a range from 4 to 9, preferably 5 to 8 and more preferably 6.5 to 7.5. Organic acids are preferred in particular, and polybasic acids are particularly preferred thereamong. Formic acid, citric acid and acetic acid are preferred organic acids, and citric acid is particularly preferred on account of its odor neutrality. The gas-forming gas element comprises preferably at least one of the

above-described compounds in an amount of at least 10%, preferably at least 30% and more preferably at least 50% by weight, all percentages being based on the gas-forming gas element.

It is further preferred according to the invention that the stiffening or gas-forming gas element or both are surrounded at least partially and preferably completely by a layer, the engineering of this layer and the manner of the surroundings ensuring that the use of the stiffening element or of the gas-forming gas element does not give rise to any deterioration in the wear comfort of the hygiene article or to health hazards. Furthermore, these layers secure the stiffening or gas-forming gas element or both at a predetermined location in the hygiene article. Of particular suitability in this connection are semipermeable foils which on the one hand enable body fluids to penetrate, so that the stiffening element or gas-forming gas element can come into contact with the body fluid, but on the other hand prevent excessively rapid escaping of materials released by the stiffening element or the gas-forming gas element. Especially with regard to the gas-forming gas element is it advantageous for this foil to hold back the formed gas until the hygiene article has been at least partially expanded by the gas formed. This leads to a tighter fit for the hygiene article and signals the penetration of body fluid into the hygiene article to the wearer through the change in wear comfort. Such layers or foils comprise preferably thermoplastic

polymer and copolymers and also thermoplastic elastomers, for example polyamides such as nylon, polyesters such as polyethylene terephthalate, polyolefins such as polyethylene or polypropylene, copolymers of ethylene and ethyl acrylate, thermoplastic polyurethanes, thermoplastic polyesters, of which polypropylene, polyethylene and copolymers of polyethylene and polypropylene are particularly preferred.

Either of the two elements, preferably the gas-forming gas element, may in addition to the gas-forming substances comprise absorbent material other than these substances; this absorbent material preferably in an amount of not more than 10%, more preferably not more than 40% and even more preferably not more than 60% by weight, all percentages being based on the respective element.

It is further preferred according to the invention that the hygiene article comprise as hygiene component (A) an at least partially body fluid permeable toplayer, (B) optionally, preferably mandatorily, an outer layer, (C) optionally, preferably mandatorily, a distribution layer, (D) an absorption layer and also (E) a layer which includes the stiffening or gas-forming gas element or both or preferably a plurality of these element, wherein the toplayer, if appropriate, preferably mandatorily, the distribution layer and also the absorption layer are in at least partial liquid contact when the article is brought into contact with a liquid, and if appropriate, preferably mandatorily, is at least partially surrounded by the

outer layer, wherein the stiffening element or the gas-forming gas element or both is disposed at least partially as per one variant (i) between the absorption layer and the outer layer, or (ii) between the distribution layer and the absorption layer, or (iii) in the absorption layer or in at least two of the variants (i) to (iii). Particular preference according to the invention is given to a hygiene article which comprises all hygiene article components (A) to (E).

All liquid-pervious materials suitable to one skilled in the art come into consideration for use as body fluid permeable toplayer. It is preferred according to the invention that the toplayer be formed from a fiber-comprising material, wherein the fibers are preferably laid, loop-formingly knitted or woven, so that a sheetlike structure having pores is formed, wherein the pores are such that the body fluid is capable of passing through the toplayer sufficiently rapidly for no body fluid puddles to form on the toplayer in the event of urination.

The outer layer of the hygiene article according to the invention is preferably more liquid-impervious than the toplayer. Preferably, the outer layer is formed from polyethylene or polypropylene foils into which fibers may optionally be incorporated. The outer layer is such that it is practically body fluid impervious while possessing a certain gas perviousness, so that for example the gases formed by the wearer of the hygiene article can escape through the outer layer. It is preferred in this connection for the outer layer to have a

sufficient porosity, the water vapor transmission rate (ASTM E96) being between 400-6000 g/m^2 in 24 h, preferably 750-2800 g/m^2 in 24 h and more preferably 1000-2600 g/m^2 in 24 h.

The distribution layer in a hygiene article according to the invention ensures that the body fluid which penetrates in a limited area which is small compared with the total area of the toplayer of the hygiene article is distributed across the absorption layer disposed underneath the distribution layer sufficiently rapidly for there to be no body fluid buildups on the toplayer. In one embodiment of the hygiene article according to the invention the distribution layer and the absorption layer are combined with each other into a single layer which acts not only as a distribution layer but also as an absorption layer. The distribution layer preferably comprises manufactured or cellulosic fibers which are laid, loop-formingly knitted or woven, preferably laid.

The absorption layer includes an absorbent material. Absorbent material refers to materials which are capable of absorbing at least 10, preferably at least 50 and more preferably at least 100 %[*sic*] of their own weight of water. An absorption layer contains preferably 10%, more preferably at least 50% and even more preferably at least 70% by weight, based on the absorption layer, of absorbent material. It is particularly preferable that the absorption layer comprise an absorbent polymer as absorbent material.

The absorbent polymer is preferably based on

(α1) 0.1% to 99.999% by weight, preferably 20% to 98.99% by weight and more preferably 30% to 98.95% by weight of polymerized ethylenically unsaturated acid-functional monomers or their salts or polymerized ethylenically unsaturated protonated or quaternized nitrogen monomers, or mixtures thereof, with mixtures comprising at least ethylenically unsaturated acid-functional monomers, preferably acrylic acid, being particularly preferred,

(α2) 0% to 70% by weight, preferably 1% to 60% by weight and more preferably 1% to 40% by weight of polymerized ethylenically unsaturated monomers copolymerizable with (α1),

(α3) 0% to 10% by weight, preferably 0.01% to 7% by weight and more preferably 0.05% to 5% by weight of one or more crosslinkers,

(α4) 0% to 30% by weight, preferably 1% to 20% by weight and more preferably 5% to 10% by weight of water-soluble polymers, and also

(α5) 0% to 20% by weight, preferably 0.01% to 7% by weight and more preferably 0.05% to 5% by weight of one or more auxiliaries, the sum total of the weight amounts (α1) to (α5) being 100% by weight.

The monoethylenically unsaturated acid-functional monomers (α1) may be partially or completely neutralized and are preferably partially neutralized. More preferably, the monoethylenically unsaturated acid-functional monomers are at

least 25 mol%, more preferably at least 50 mol% and even more preferably 50-90 mol% neutralized. The monomers (α1) may be neutralized before [or] else after polymerization. Furthermore, they may be neutralized with alkali metal hydroxides, alkaline earth metal hydroxides, ammonia and also carbonates and bicarbonates. Any further base which forms a water-soluble salt with the acid is conceivable as well. Similarly conceivable is a mixed neutralization with various bases. Preference is given to neutralization with ammonia or with alkali metal hydroxides, more preferably with sodium hydroxide or with ammonia.

Furthermore, the free acid groups may predominate in a polymer, so that this polymer has an acidic pH. This acidic water-absorbing polymer can be at least partially neutralized by means of a polymer having free basic groups, preferably amine groups, which is basic compared with the acidic polymer. These polymers are known in the literature as mixed-bed ion-exchange absorbent polymers (MBIEA polymers) and are disclosed inter alia in WO 99/34843. The disclosure of WO 99/34843 is hereby introduced as a reference and thus is deemed to be part of the disclosure. In general, MBIEA polymers constitute a composition which comprises not only basic polymers capable of exchanging anions, but also a polymer which compared with the basic polymer is acidic and which is capable of exchanging cations. The basic polymer has basic groups and is typically obtained by addition polymerization of monomers which bear basic groups or groups which can be transformed into basic groups. These monomers are

primarily monomers which comprise primary, secondary or tertiary amines or the corresponding phosphines or at least two of the above functional groups. This group of monomers includes in particular ethyleneamine, allylamine, diallylamine, 4-aminobutene, alkyloxycyclines [*sic*], vinylformamide, 5-aminopentene, carbodiimide, formaldacine [*sic*], melanin [*sic*], and the like, and also their secondary or tertiary amine derivatives.

Preferred monoethylenically unsaturated acid-functional monomers (α1) are acrylic acid, methacrylic acid, ethacrylic acid, α-chloroacrylic acid, α-cyanoacrylic acid, β-methylacrylic acid (crotonic acid), α-phenylacrylic acid, β-acryloyloxypropionic acid, sorbic acid, α-chlorosorbic acid, 2'-methyliso-crotonic acid, cinnamic acid, p-chlorocinnamic acid, β-stearylic acid, itaconic acid, citraconic acid, mesaconic acid, glutaconic acid, aconitic acid, maleic acid, fumaric acid, tricarboxyethylene and maleic anhydride, of which acrylic acid and methacrylic acid are particularly and acrylic acid is more particularly preferred.

As well as these carboxylate-functional monomers, monoethylenically unsaturated acid-functional monomers (α1) further preferably include ethylenically unsaturated sulfonic acid monomers or ethylenically unsaturated phosphonic acid monomers.

Ethylenically unsaturated sulfonic acid monomers are allylsulfonic acid or aliphatic or aromatic vinylsulfonic acids

or acrylic or methacrylic sulfonic acids. Preferred aliphatic or aromatic vinylsulfonic acids are vinylsulfonic acid, 4-vinylbenzylsulfonic [*sic*] acid, vinyltoluylenesulfonic acid and styrenesulfonic acid. Preferred acryloyl- and methacryloylsulfonic acids are sulfoethyl (meth)acrylate, sulfopropyl (meth)acrylate and 2-hydroxy-3-methacryloyloxypropylsulfonic acid. A preferred (meth)acrylamidoalkylsulfonic acid is 2-acrylamido-2-methylpropanesulfonic acid.

Preference is further given to ethylenically unsaturated phosphonic acid monomers, such as vinylphosphonic acid, allylphosphonic acid, vinylbenzylphosphonic acid, (meth)acrylamidoalkyl-phosphonic acids, acrylamidoalkyldiphosphonic acids, phosphonomethylated vinylamines and (meth)acryloyl-phosphonic acid derivatives.

Preference for use as ethylenically unsaturated protonated nitrogen monomers (α1) is given to dialkylaminoalkyl (meth)acrylates in protonated form, for example dimethylaminoethyl (meth)acrylate hydrochloride or dimethylaminoethyl (meth)acrylate hydrosulfate, and also dialkylaminoalkyl(meth)acrylamides in protonated form, for example dimethylaminoethyl(meth)acrylamide hydrochloride, diemethylaminopropyl(meth)acrylamide [*sic*] hydrochloride, diemethylaminopropyl(meth)acrylamide [*sic*] hydrosulfate or dimethylaminoethyl(meth)acrylamide hydrosulfate.

Preference for use as ethylenically unsaturated

quaternized nitrogen monomers (α1) is given to dialkylammonioalkyl (meth)acrylates in quaternized form, for example trimethylammonioethyl (meth)acrylate methosulfate or dimethylethylammonioethyl (meth)acrylate ethosulfate and also (meth)acrylamidoalkyldialkylamines in quaternized form, for example (meth)acrylamidopropyl-trimethylammonium chloride, tremethylammonioethyl [*sic*] (meth)acrylate chloride or (meth)acrylamidopropyl-trimethylammonium sulfate.

It is preferred according to the invention that the polymer comprise at least 50% by weight, preferably at least 70% by weight and more preferably at least 90% by weight of carboxylate-functional monomers. It is particularly preferable according to the invention that the polymer comprise at least 50% by weight and preferably at least 70% by weight of acrylic acid, which is preferably at least 20 mol% and more preferably at least 50 mol% neutralized.

Preference for use as monoethylenically unsaturated monomers (α2) copolymerizable with (α1) is given to acrylamides and methacrylamides.

Possible (meth)acrylamides in addition to acrylamide and methacrylamide include alkyl-substituted (meth)acrylamides or aminoalkyl-substituted derivatives of (meth)acrylamide, such as N-methylol(meth)acrylamide, N,N-dimethylamino(meth)acrylamide, dimethyl(meth)acrylamide or diethyl(meth)acrylamide. Possible vinylamides are for example N-vinylamides, N-vinylformamides, N-vinylacetamides, N-vinyl-N-methylacetamides, N-vinyl-

N-methylformamides, vinylpyrrolidone. Acrylamide is particularly preferred among these monomers.

Preference for use as monoethylenically unsaturated monomers (α2) copolymerizable with (α1) is further given to water-dispersible monomers. Preferred water-dispersible monomers are acrylic esters and methacrylic esters, such as methyl (meth)acrylate, ethyl(meth)acrylate, propyl (meth)acrylate or butyl (meth)acrylate, and also vinyl acetate, styrene and isobutylene. These water-dispersible monomers are preferably used in an amounts [*sic*] in the range from 0.01% to 20% by weight, preferably from 0.1% to 15% and more preferably from 0.5% to 5% by weight, based on total monomers used.

It is additionally preferred according to the invention that the absorbent polymer be crosslinked by a chemical crosslinker (α3) or by thermal crosslinking or radiative crosslinking or at least two thereof, although crosslinking by a chemical crosslinker (α3) is preferred.

Preferred crosslinkers (α3) for the invention are compounds which comprise at least two ethylenically unsaturated groups within a molecule (crosslinker class I), compounds which comprise at least two functional groups which are capable of reacting with functional groups of the monomers (α1) or (α2), preferably in a condensation reaction (= condensation crosslinker), in an addition reaction or in a ring-opening reaction (crosslinker class II), compounds which comprise at least one ethylenically unsaturated group and at least one

functional group capable of reacting with functional groups of the monomers (α1) or (α2) (crosslinker class III), or polyvalent metal cations (crosslinker class IV). The compounds of crosslinker class I provide crosslinking of the polymers through free-radical polymerization of the ethylenically unsaturated groups of the crosslinker molecule with the monoethylenically unsaturated monomers (α1) or (α2), whereas the compounds of crosslinker class II and the polyvalent metal cations of crosslinker class IV provide crosslinking of the polymers through reaction of the functional groups (crosslinker class II) or through electrostatic interaction of the polyvalent metal cation (crosslinker class IV) with the functional groups of the monomers (α1) or (α2). The compounds of crosslinker class III correspondingly provide crosslinking of the polymer through free-radical polymerization of the ethylenically unsaturated group as well as through reaction between the functional group of the crosslinker and the functional groups of the monomers (α1) or (α2).

Preferred compounds of crosslinker class I are poly(meth)acrylic esters, which are obtained for example by reaction of a polyol, such as for example ethylene glycol, propylene glycol, trimethylolpropane, 1,6-hexanediol, glycerol, pentaerythritol, polyethylene glycol or polypropylene glycol, of an amino alcohol, of a polyalkylenepolyamine, such as for example diethylenetriamine or triethylenetetraamine, or of an alkoxylated polyol with acrylic acid or methacrylic acid.

Preferred compounds of crosslinker class I further include polyvinyl compounds, poly(meth)allyl compounds, (meth)acrylic esters of a monovinyl compound or (meth)acrylic esters of a mono(meth)allyl compound, preferably the mono(meth)allyl compounds of a polyol or of an amino alcohol. Reference is made in this context to DE 195 43 366 and DE 195 43 368. The disclosures are hereby incorporated by reference and thus constitute part of the disclosure.

Examples of compounds of crosslinker class I which may be mentioned are alkenyl di(meth)acrylates, for example ethylene glycol di(meth)acrylate, 1,3-propylene glycol di(meth)acrylate, 1,4-butylene glycol di(meth)acrylate, 1,3-butylene glycol di(meth)acrylate, 1,6-hexanediol di(meth)acrylate, 1,10-decanediol di(meth)acrylate, 1,12-dodecanediol di(meth)acrylate, 1,18-octadecanediol di(meth)acrylate, cyclopentanediol di(meth)acrylate, neopentylglycol di(meth)acrylate, methylene di(meth)acrylate or pentaerythritol di(meth)acrylate, alkenyldi(meth)acrylamides, for example N-methyldi(meth)acrylamide, N,N'-3-methylbutylidenebis-(meth)acrylamide, N,N'-(1,2-dihydroxyethylene)bis-(meth)acrylamide, N,N'-hexamethylenebis(meth)acrylamide or N,N'-methylenebis(meth)acrylamide, polyalkoxydi-(meth)acrylates, for example diethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, dipropylene glycol di(meth)acrylate, tripropylene glycol di(meth)acrylate or tetrapropylene glycol di(meth)acrylate,

bisphenol A di(meth)acrylate, ethoxylated bisphenol A di(meth)acrylate, benzylidene di(meth)acrylate, 1,3-di(meth)acryloyloxy-2-propanol, hydroquinone di(meth)acrylate, di(meth)acrylate ester of a trimethylolpropane which has preferably been alkoxylated, preferably ethoxylated, with 1 to 30 mol of alkylene oxide per hydroxyl group, thioethylene glycol di(meth)acrylate, thiopropylene glycol di(meth)acrylate, thiopolyethylene glycol di(meth)acrylate, thiopolypropylene glycol di(meth)acrylate, divinyl ethers, for example 1,4-butanediol divinyl ether, divinyl esters, for example divinyl adipate, alkanedienes, for example butadiene or 1,6-hexadiene, divinylbenzene, di(meth)allyl compounds, for example di(meth)allyl phthalate or di(meth)allyl succinate, homo- and copolymers of di(meth)allyldimethylammonium chloride and homo- and copolymers of diethyl(meth)-allylaminomethyl (meth)acrylate ammonium chloride, vinyl(meth)acryloyl compounds, for example vinyl (meth)acrylate, (meth)allyl(meth)acryloyl compounds, for example (meth)allyl (meth)acrylate, (meth)allyl (meth)acrylate which has been ethoxylated with 1 to 30 mol of ethylene oxide per hydroxyl group, di(meth)allyl esters of polycarboxylic acids, for example di(meth)allyl maleate, di(meth)allyl fumarate, di(meth)allyl succinate or di(meth)allyl terephthalate, compounds having 3 or more ethylenically unsaturated, free-radically polymerizable groups such as for example glycerol tri(meth)acrylate, (meth)acrylate ester of the glycerol which has preferably been ethoxylated with 1 to 30 mol

of ethylene oxide per hydroxyl group, trimethylolpropane tri(meth)acrylate, tri(meth)acrylate ester of the trimethylolpropane preferably alkoxylated, preferably ethoxylated, with 1 to 30 mol of alkylene oxide per hydroxyl group, trimethacrylamide, (meth)allylidene di(meth)acrylate, 3-allyloxy-1,2-propanediol di(meth)acrylate, tri(meth)allyl cyanurate, tri(meth)allyl isocyanurate, pentaerythritol tetra(meth)acrylate, pentaerythritol tri(meth)acrylate, (meth)acrylic ester of the pentaerythritol ethoxylated with preferably 1 to 30 mol of ethylene oxide per hydroxyl group, tris(2-hydroxyethyl) isocyanurate tri(meth)acrylate, trivinyl trimellitate, tri(meth)allylamine, di(meth)allylalkylamines, for example di(meth)allylmethylamine, tri(meth)allyl phosphate, tetra(meth)allylethylenediamine, poly(meth)allyl esters, tetra(meth)allyloxyethane or tetra(meth)allylammonium halides.

Preference for use as a compound of crosslinker class II is given to compounds which comprise at least two functional groups which are capable of reaction in a condensation reaction (= condensation crosslinkers), in an addition reaction or in a ring-opening reaction with the functional groups of the monomers (α1) and (α2), preferably with acid groups, of the monomers (α1). These functional groups of compounds of crosslinker class II are preferably alcohol, amine, aldehyde, glycidyl, isocyanate, carbonate or epichloro functions.

As a compound of crosslinker class II there may be mentioned as examples: polyols, for example ethylene glycol,

polyethylene glycols such as diethylene glycol, triethylene glycol and tetraethylene glycol, propylene glycol, polypropylene glycols such as dipropylene glycol, tripropylene glycol or tetrapropylene glycol, 1,3-butanediol, 1,4-butanediol,1,5-pentanediol, 2,4-pentanediol, 1,6-hexanediol, 2,5-hexanediol, glycerol, polyglycerol, trimethylolpropane, polyoxypropylene, oxyethylene-oxypropylene block copolymers, sorbitan fatty acid esters, polyoxyethylene sorbitan fatty acid esters, pentaerythritol, polyvinyl alcohol and sorbitol, amino alcohols, for example ethanolamine, diethanolamine, triethanolamine or propanolamine, polyamine compounds, for example ethylenediamine, diethylenetriamine, triethylene-tetraamine, tetraethylenepentaamine or pentaethylenehexaamine, polyglycidyl ether compounds such as ethylene glycol diglycidyl ether, polyethylene glycol diglycidyl ether, glycerol diglycidyl ether, glycerol polyglycidyl ether, pentaerythritol polyglycidyl ether, propylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, neopentylglycol diglycidyl ether, hexanediol glycidyl ether, trimethylolpropane polyglycidyl ether, sorbitol polyglycidyl ether, diglycidyl phthalate, adipic acid diglycidyl ether [*sic*], 1,4-phenylene-bis(2-oxazoline), glycidol, polyisocyanates, preferably diisocyanates such as 2,4-toluene diisocyanate and hexamethylene diisocyanate, polyaziridine compounds such as 2,2-bis-hydroxymethylbutanol tris[3-(1-aziridinyl)propionate], 1,6-hexamethylenediethyleneurea and diphenylmethane-bis-4,4'-N,N'-diethyleneurea, haloepoxides for

example epichloro- and epibromohydrin and α-methyl-epichlorohydrin, alkylene carbonates such as 1,3-dioxolan-2-one (ethylene carbonate), 4-methyl-1,3-dioxolan-2-one (propylene carbonate), 4,5-dimethyl-1,3-dioxolan-2-one, 4,4-dimethyl-1,3-dioxolan-2-one, 4-ethyl-1,3-dioxolan-2-one, 4-hydroxymethyl-1,3-dioxolan-2-one, 1,3-dioxan-2-one, 4-methyl-1,3-dioxan-2-one, 4,6-dimethyl-1,3-dioxan-2-one, 1,3-dioxolan-2-one, poly-1,3-dioxolan-2-one, polyquaternary amines such as condensation products of dimethylamines and epichlorohydrin. Preference for use as compounds of crosslinker class II is further given to polyoxazolines such as 1,2-ethylenebisoxazoline, crosslinkers having silane groups such as γ-glycidoxypropyltrimethoxysilane and γ-aminopropyltrimethoxysilane, oxazolidinones such as 2-oxazolidinone, bis- and poly-2-oxazolidinones and diglycol silicates.

Preferred compounds of class III are hydroxyl- or amino-containing esters of (meth)acrylic acid, such as for example 2-hydroxyethyl (meth)acrylate, and also hydroxyl- or amino-containing (meth)acrylamides, or mono(meth)allyl compounds of diols.

The polyvalent metal cations of crosslinker class IV are preferably derived from uni- or multivalent cations, the univalent ones in particular from alkali metals, such as potassium, sodium, lithium, of which lithium is preferred. Preferred divalent cations are derived from zinc, beryllium, alkaline earth metals, such as magnesium, calcium, strontium, of

which magnesium is preferred. More highly valent cations which can be used according to the invention are further cations of aluminum, iron, chromium, manganese, titanium, zirconium and other transition metals and also double salts of such cations or mixtures of the salts mentioned. Preference is given to the use of aluminum compounds such as the Paper-PAC-N® polyaluminum compounds or aluminum salts and alums and their different hydrates such as for example $AlCl_3 \times 6H_2O$, $NaAl(SO_4)_2 \times 12\ H_2O$, $KAl(SO_4)_2 \times 12\ H_2O$ or $Al_2(SO_4)_3 \times 14\text{-}18\ H_2O$.

Particular preference for use as crosslinkers of crosslinking class IV is given to $Al_2(SO_4)_3$ and its hydrates.

Preferred absorbent polymers are polymers which are crosslinked by crosslinkers of the following crosslinker classes or by crosslinkers of the following combinations of crosslinker classes: I, II, III, IV, I II, I III, I IV, I II III, I II IV, I III IV, II III IV, II IV or III IV. The above combinations of crosslinker classes each constitute a preferred embodiment of crosslinkers of an absorbent polymer.

Further preferred embodiments of the absorbent polymers are polymers which are crosslinked by any of the aforementioned crosslinkers of crosslinker classes I. Water-soluble crosslinkers are preferred among these. Particular preference is given in this context to N,N'-methylenebisacrylamide, polyethylene glycol di(meth)acrylates, triallylmethylammonium chloride, tetraallylammonium chloride and also to allylnonaethylene glycol acrylate prepared using 9 mol of ethylene oxide

per mole of acrylic acid.

The absorbent polymer can be prepared from the aforementioned monomers and crosslinkers in various ways. Examples to be mentioned in this context are mass polymerization, solution polymerization, spray polymerization, inverse emulsion polymerization and inverse suspension polymerization. Preferably, the solution polymerization is carried out in water as a solvent. The solution polymerization can be carried out as a continuous operation or as a batch operation. The prior art reveals a broad spectrum of possible variations with regard to reaction conditions such as temperatures, type and amount of initiators and also of the reaction solution. Typical processes are described in the following patent specifications: US 4,286,082, DE 27 06 135, US 4,076,663, DE 35 03 458, DE 40 20 780, DE 42 44 548, DE 43 23 001, DE 43 33 056, DE 44 18 818. The disclosures are hereby introduced as a reference and thus are deemed to be part of the disclosure.

Another way to prepare the absorbent polymers consists in first preparing uncrosslinked, especially linear, polymers, preferably free-radically, from the aforementioned monoethylenically unsaturated monomers (α1) or (α2) and then to react these with crosslinking reagents (α3), preferably with those of classes II and IV. This version is preferred when the water-absorbing polymers are to be first processed in shape-conferring processes, for example, into fibers, self-supporting

films or other sheetlike structures, such as wovens, formed-loop knits, tissues or nonwovens and are to be crosslinked in this form.

Polymerization initiators may be present in solution or dispersion in a solution of monomers according to the invention. Useful initiators include all compounds which disintegrate into free radicals and are known to one skilled in the art. They include in particular peroxides, hydroperoxides, hydrogen peroxide, persulfates, azo compounds and also the so-called redox catalysts. The use of water-soluble catalysts is preferred. It is advantageous in some cases to use mixtures of various polymerization initiators. Preferred among these mixtures are those of hydrogen peroxide and sodium peroxodisulfate or potassium peroxodisulfate, which can be used in every conceivable mixing ratio. Suitable organic peroxides preferably include acetylacetone peroxide, methyl ethyl ketone peroxide, t-butyl hydroperoxide, cumene hydroperoxide, t-amyl perpivalate, t-butyl perpivalate, t-butyl neohexanoate, t-butyl isobutyrate, t-butyl per-2-ethylhexenoate, t-butyl perisononanoate, t-butyl permaleate, t-butyl perbenzoate, t-butyl 3,5,5-trimethylhexanoate and amyl perneodecanoate. Preference for use as polymerization initiators is further given to: azo compounds, such as 2,2'-azobis(2-amidinopropane) dihydrochloride, azobisamidinopropane dihydrochloride, 2,2'-azobis(N,N-dimethylene)isobutyramidine dihydrochloride, 2-(carbamoylazo)isobutyronitrile and 4,4'-azobis(4-cyanovaleric

acid). The compounds mentioned are used in customary amounts, preferably in a range from 0.01 to 5 and preferably from 0.1 to 2 mol%, each based on the amount of monomers to be polymerized.

Redox catalysts contain at least one of the above-indicated per compounds as an oxidic component and preferably ascorbic acid, glucose, sorbose, mannose, ammonium hydrogensulfite, ammonium hydrogensulfate, ammonium thiosulfate, ammonium hyposulfite or ammonium sulfide, alkali metal hydrogensulfite, alkali metal sulfate, alkali metal thiosulfate, alkali metal hyposulfite or alkali metal sulfide, metal salts, such as iron(II) ions or silver ions or sodium hydroxymethylsulfoxylate as reducing component. The reducing component of the redox catalyst is preferably ascorbic acid or sodium pyrosulfite. Based on the amount of monomers used in the polymerization, from $1*10^{-5}$ to 1 mol% of the reducing component of the redox catalyst and from $1*10^{-5}$ to 5 mol% of the oxidizing component of the redox catalyst is used. Instead of the oxidizing component of the redox catalyst or in addition to the redox catalyst it is possible to use one or more, preferably water-soluble, azo compounds.

A redox system consisting of hydrogen peroxide, sodium peroxodisulfate and ascorbic acid is preferably used according to the invention. In general, azo compounds are preferred according to the invention as initiators, and azobisamidinopropane dihydrochloride is particularly preferred. The polymerization is generally initiated with the initiators in

a temperature range from 30 to 90°C.

So-called "postcrosslinkers", with which the absorbent polymer has preferably been additionally treated, usually in the region of the surface of the polymeric particles, are particularly suitably selected from the compounds of crosslinker classes II and IV that were mentioned in connection with crosslinkers (α3).

Particular preference for use as postcrosslinkers among these compounds is given to diethylene glycol, triethylene glycol, polyethylene glycol, glycerol, polyglycerol, propylene glycol, diethanolamine, triethanolamine, polyoxypropylene, oxyethylene-oxypropylene block copolymers, sorbitan fatty acid esters, polyoxyethylene sorbitan fatty acid esters, trimethylolpropane, pentaerythritol, polyvinyl alcohol, sorbitol, 1,3-dioxolan-2-one (ethylene carbonate), 4-methyl-1,3-dioxolan-2-one (propylene carbonate), 4,5-dimethyl-1,3-dioxolan-2-one, 4,4-dimethyl-1,3-dioxolan-2-one, 4-ethyl-1,3-dioxolan-2-one, 4-hydroxymethyl-1,3-dioxolan-2-one, 1,3-dioxan-2-one, 4-methyl-1,3-dioxan-2-one, 4,6-dimethyl-1,3-dioxan-2-one, 1,3-dioxolan-2-one, poly-1,3-dioxolan-2-one. It is particularly preferred to use ethylene carbonate as a postcrosslinker.

Preferred embodiments of the polymers are those which are postcrosslinked by crosslinkers of the following crosslinker classes or by crosslinkers of the following combinations of crosslinker classes: II, IV and II IV.

Further preferred embodiments of the polymers are those

which have been postcrosslinked by any of the crosslinkers mentioned above in crosslinker classes II or IV.

These compounds are preferably used in an amount in the range from 0.01% to 30%, preferably 0.1% to 20% and more preferably 0.5% to 10% by weight, based on the still untreated polymer. Organic solvents may be added to the mixture in an amount from 0% to 60%, preferably 0.1% to 40% and more preferably 0.2% to 50% by weight, based on the still untreated polymer. Preferred organic solvents are lower alcohols such as methanol, ethanol, n-propanol, isopropanol, n-butanol, isobutanol, sec-butanol and t-butanol, ketones such as acetone, methyl ethyl ketone and methyl isobutyl ketone, ethers such as dioxane, tetrahydrofuran and diethyl ethers, amides such as N,N-dimethylformamide and N,N-diethylformamide and also sulfoxides such as dimethyl sulfoxide.

As water-soluble polymers ($\alpha 4$), the absorbent polymers may contain, preferably in polymerized form, water-soluble addition polymers, such as partially or fully hydrolyzed polyvinyl alcohol, polyvinylpyrrolidone, starch or starch derivatives, polyglycols or polyacrylic acid. The molecular weight of these polymers is not critical as long as they are water soluble. Preferred water-soluble polymers are starch or starch derivatives or polyvinyl alcohol. The water-soluble polymers, preferably synthetic ones such as polyvinyl alcohol, can also serve as a grafting base for the monomers to be polymerized.

As auxiliaries (α5), the absorbent polymers preferably contain standardizers, odor binders or antioxidants. These auxiliaries are preferably added to the monomer solution.

It is further preferred according to the invention that the absorbent polymers have an inner region, an outer region surrounding the inner region and also a surface region surrounding the outer region, the outer region having a higher degree of crosslinking than the inner region, so that preferably a core-shell structure results. The enhanced crosslinking in the surface region of the polymers is preferably achieved through postcrosslinking reactive groups close to the surface. This postcrosslinking can be effected thermally, photochemically or chemically. Preferred postcrosslinkers for chemical postcrosslinking are the compounds which were mentioned as crosslinkers (α3) of crosslinker classes II and IV. Ethylene carbonate is particularly preferred as a postcrosslinker.

Preferably, the absorbent material and especially the absorbent polymer exhibits at least one of the following properties:

(a1) ERT 440.1-99 maximum uptake of 0.9% by weight aqueous NaCl solution in a range from 10 to 1000, preferably from 15 to 500 and more preferably from 20 to 300 ml/g,

(b1) ERT 470.1-99 0.9% by weight aqueous NaCl solution extractables of less than 30%, preferably less than 20% and more preferably less than 10% by weight, based on the untreated absorbent polymeric structure,

(c1) ERT 440.1-99 swell time to achieve 80% maximum absorption of 0.9% by weight aqueous NaCl solution in the range from 0.01 to 180, preferably from 0.01 to 150 and more preferably from 0.01 to 100 min,

(d1) ERT 460.1-99 density in the range from 300 to 1000, preferably 310 to 800 and more preferably 320 to 700 g/l,

(e1) ERT 400.1-99 pH for 1 g of the untreated absorbent polymeric structure in 1 l of water in the range from 4 to 10, preferably from 5 to 9 and more preferably from 5.5 to 7.5,

(f1) ERT 442.1-99 CRC in the range from 10 to 100, preferably 15 to 80 and more preferably 20 to 60 g/g,

(g1) ERT 442.1-99 AAP in the range from 10 to 60, preferably 15 to 50 and more preferably 20 to 40 g/g.

The combinations of two or more of the above properties as well as each individual property each constitute preferred embodiments of the present invention. Particular preference as embodiments of the present invention is further given to the properties or property combinations shown hereinbelow as letter or letter combinations: a1, b1, c1, d1, e1, f1, g1, a1b1, a1c1, a1d1, a1f1, a1g1, f1b1, f1c1, f1d1, g1b1, g1c1, g1d1, f1g1c1, f1g1d1, f1g1b1, a1f1b1, a1f1c1, a1g1b1, a1g1c1, a1f1d1, a1g1d1, a1f1g1, a1f1g1b1, a1f1g1c1, a1f1g1d1, a1f1b1c1, a1g1b1c1, a1f1d1c1, a1g1d1b1, a1f1b1d1, a1g1c1d1, f1g1c1b1, f1g1d1b1, f1g1c1d1, a1f1g1b1c1, a1f1g1c1d1, a1f1g1d1b1, a1b1c1d1f1g1, a1b1c1d1e1f1g1.

The invention further provides a process for producing an absorbent hygiene article, which process comprises uniting (a) a stiffening element which stiffens in contact with body fluids or (b) a gas element which forms a gas in contact with fluids, or both in (c) at least one hygiene article component.

The process of the present invention is preferably carried out by the incorporating being effected by mixing in the stiffening or gas-forming gas element. In another embodiment, the stiffening element or the gas-forming gas element can be placed between various hygiene article component plies to produce a hygiene article. This can be effected for example in a diaper machine by the stiffening or gas-forming gas element made up into a roll material being inserted between the appropriate hygiene component plies or onto the appropriate hygiene component ply.

The invention further provides an absorbent hygiene article which is obtainable by the above-described process of the present invention.

The invention also provides for the use of the present invention's absorbent hygiene article and also of the absorbent hygiene article obtainable by the process of the present invention to assist the toilet training of children aged from 0.5 to 5 years.

The invention also provides for the use of (α) a stiffening element which stiffens in contact with body fluids or of (β) a gas element which forms a gas in contact with body

fluids, or both in a hygiene article to control a wearer's inclination to urinate or as a urination indicator. Preference for use as stiffening element and as gas-forming gas element is given to those elements which have already been mentioned in connection with the present invention's absorbent hygiene article.

The invention will now be more particularly described with reference to nonlimiting drawings and examples.

Figures 1 to 3 show cross sections through the construction of a hygiene article.

Figures 4 and 5 show a plan view of a hygiene article construction.

Figure 1 shows a construction of a hygiene article in which there is disposed, between a liquid-permeable toplayer 1 and an outer layer 2, a distribution layer 3 adjacent to the toplayer 1, followed by an absorption layer 4 and a layer 5, which comprises a stiffening or a gas-forming gas element or both, one side of the layer 5, which comprises a stiffening and a gas-forming gas element, facing the outer layer 2.

Figure 2 shows a construction of a further embodiment of the hygiene article according to the present invention, wherein, unlike Figure 1, the layer 5, which comprises the stiffening or gas-forming gas element or both, is disposed between the distribution layer 3 and the absorption layer 4.

Figure 3 shows the construction of a hygiene article which differs from the construction as per Figure 1 in that the

layer 5, which comprises the stiffening or gas-forming gas element or both, has been received into the absorption layer 4, the layer 5 being surrounded by the absorption layer 4 even at those sides of the construction in which the toplayer 1 and the outer layer 2 meet.

Figure 4 shows a plan view of a hygiene article 6 in which a layer 5 which comprises a stiffening or a gas-forming gas element or both is disposed, the boundaries of the layer 5 lying within the boundaries of the hygiene article 6 and the longest dimension of the layer 5 and the longest dimension of the hygiene article 6 being congruent and the area of layer 5 when viewed in plan view against the hygiene article 6 covering between 1/3 and 2/3 of the area of hygiene article 6.

Figure 5 shows a hygiene article which differs from the hygiene article as per Figure 4 in that the area of layer 5 in plan view of the hygiene article 6 accounts for between 1/5 and 1/3 of the area of the hygiene article 6.

Figure 6 shows the test method for force measurement.

TEST METHODS

DETERMINATION OF STIFFNESS OF DIAPER WITH STIFFENING ELEMENT

The stiffness of the diaper is determined by a diaper (7) comprising a stiffening element (8) which was brought into contact with liquid being removed from the body-shaped apparatus known as kanga and being placed at both ends on a flat support (9) (see Figure 6) so that the diaper forms a half-ring. Two

lateral confinements (11) prevent the diaper sliding away to the side. Weights (10) of 500 g, 1000 g and 1500 g are placed in succession in the middle of the highest point of the diaper. The test is to see at which weight the middle of the diaper touches the support within 30 seconds. Diapers without the stiffening element cannot be placed stably on a support with their two ends. They immediately collapse.

EVALUATION OF GAS DEVELOPMENT OF DIAPER WITH GAS ELEMENT

The diaper with pad is spread out flat on a table and fixed in place. A plastic plate having the dimensions of the pad is placed on the diaper surface at the point where the pad is situated. The weight of the plate is to be chosen such that a pressure of 2 g/cm^2 acts on the diaper surface. A graduated ruler is put in place as well as the plate. At the middle of the plate is a fill opening in the form of a tube into which an appropriate amount of liquid is added. It is then observed when the plate rises by at least 2 mm and for how long.

EXAMPLES

1. A diaper of the 'Huggis [*sic*] brand (manufactured by Kimberly-Clark, Barton, England) was slit open at the side. A ply of a Plastrona® plaster bandage from Paul Hartmann AG was placed between the absorption layer and the outer layer (see Figure 1 and Figure 4), so that it came to lie in the middle in the longitudinal direction of the diaper. The

diaper was clamped into a body-shaped apparatus (kanga) and impinged with 200 ml of 0.9% NaCl solution. The diaper was removed after about 10 minutes and placed upside down on a flat support. A weight of 500 g placed on top was not sufficient to press the lower side of the diaper down to the flat support. At 1000 g, the underside of the diaper was pressed down to the support within 30 seconds.

2. A diaper of the Huggis [*sic*] brand (manufactured by Kimberly-Clark, Barton, England) was slit open at the side. A ply of a Scotchcast™ plastic bandage from Laboratoires 3M Santé was placed between the absorption layer and the outer layer (see Figure 1 and Figure 4), so that it came to lie in the middle in the longitudinal direction of the diaper. The diaper was clamped into a body-shaped apparatus (kanga) and impinged with 200 ml of 0.9% NaCl solution. The diaper was removed after about 10 minutes and placed upside down on a flat support. A weight of 500 g placed on top was not sufficient to press the lower side of the diaper down to the flat support. At 1000 g, the underside of the diaper was pressed down to the support within 30 seconds.

3. Two sheets 10 cm in length and 8 cm in width of a hot-sealable material (Dexter Paper, Nonwoven: mass per area: 16.5 ± 1.5 g/m^2, thermoplastic fiber content: 4 ± 0.8 g/m^2, wet tensile strength in cross direction: 70 ± 12 N/m, air

perviousness: 230 ± 50 L/min/100 cm^2) were welded together to form a bag into which 10 g of a mixture of 0.5 g of Favor® SXM 880 superabsorbent from Stockhausen GmbH & Co Kg and 9.5 g of plaster from Knauf Bauprodukte (Postfach 10, 97343 Iphofen) were filled. The bag was subsequently welded shut and provided with further spot welds, distributed across the area of the bag, to prevent the powder sliding about. The bag was placed between the absorption layer and the outer layer of a diaper of the Huggis [*sic*] brand (manufactured by Kimberly-Clark, Barton, England) in accordance with Figure 5. The diaper was clamped into a body-shaped apparatus (kanga) and impinged with 200 ml of 0.9% NaCl solution. The diaper was removed after about 10 minutes and placed upside down on a flat support. A weight of 500 g placed on top was not sufficient to press the lower side of the diaper down to the flat support. At 1000 g, the underside of the diaper was pressed down to the support within 30 seconds.

4. Two sheets 10 cm in length and 8 cm in width of a hot-sealable material (Dexter Paper, Nonwoven: mass per area: 16.5 ± 1.5 g/m^2, thermoplastic fiber content: 4 ± 0.8 g/m^2, wet tensile strength in cross direction: 70 ± 12 N/m, air perviousness: 230 ± 50 L/min/100 cm^2) were welded together to form a bag into which 10 g of a mixture of 2.0 g of Favor® SXM 880 superabsorbent from Stockhausen GmbH & Co

Kg, 3 g of citric acid and 4 g of sodium bicarbonate were filled. The bag was subsequently welded shut and provided with further spot welds, distributed across the area of the bag, to prevent the powder sliding about. The bag was placed between the absorption layer and the distribution layer of a diaper of the Huggis [*sic*] brand (manufactured by Kimberly-Clark, Barton, England) in accordance with Figure 5. The diaper was tested with regard to gas evolution by the test method described above. Following addition of 100 ml of a 0.9% by weight NaCl solution the plate was raised by 2 mm for 10 minutes.

5. Two sheets 20 cm in length and 4 cm in width of a hot-sealable material (Dexter Paper, Nonwoven: mass per area: 16.5 ± 1.5 g/m^2, thermoplastic fiber content: 4 ± 0.8 g/m^2, wet tensile strength in cross direction: 70 ± 12 N/m, air perviousness: 230 ± 50 L/min/100 cm^2) were welded together to form a bag into which 16 g of a mixture of 4.0 g of Favor® SXM 880 superabsorbent from Stockhausen GmbH & Co Kg, 5 g of citric acid and 7 g of sodium bicarbonate were filled. The bag was subsequently welded shut and provided with further spot welds, distributed across the area of the bag, to prevent the powder sliding about. The bag was placed between the absorption layer and the distribution layer of a diaper of the Huggis [*sic*] brand (manufactured by Kimberly-Clark, Barton, England) in accordance with

Figure 4. The diaper was tested with regard to gas evolution by the test method described above. Following addition of 150 ml of a 0.9% by weight NaCl solution the plate was raised by 2 mm for 6 minutes.

CLAIMS

1. An absorbent hygiene article comprising

   (a) a stiffening element which stiffens in contact with body fluids

   or

   (b) a gas element which forms a gas in contact with body fluids,

   or both as an indicator

   and

   (c) at least one hygiene article component,

   wherein the stiffening element or the gas-forming gas element or both are in contact with the hygiene article component.

2. An article according to claim 1, wherein the stiffening element is a resin which stiffens in contact with body fluids or an inorganic compound which stiffens in contact with body fluids or both.

3. An article according to either preceding claim, wherein the gas-forming gas element forms CO_2 or N_2.

4. An article according to any preceding claim, wherein the stiffening element or the gas-forming gas element or both are disposed in an envelope.

5. An article according to any preceding claim, including as hygiene article component

(A) an at least partially body fluid permeable toplayer (1),

(B) optionally an outer layer (2),

(C) optionally a distribution layer (3),

(D) an absorption layer (4), and also

(E) a layer (5) which includes the stiffening element or the gas-forming gas element or both,

wherein the toplayer (1), if appropriate the distribution layer (3) and also the absorption layer (4) are in at least partial liquid contact when the article is brought into contact with a liquid, and if appropriate is at least partially surrounded by the outer layer (2), wherein the layer (5) which includes the stiffening element or the gas-forming gas element or both is disposed at least partially as per one variant

(i) between the absorption layer (4) and the outer layer (2),

or

(ii) between the distribution layer (3) and the absorption layer (4),

or

(iii) in the absorption layer (4)

or

in at least two of the variants (i) to (iii).

6. An article according to claim 5, wherein the absorption layer (4) includes an absorbent polymer.

7. A process for producing an absorbent hygiene article, which process comprises uniting

(a) a stiffening element which stiffens in contact with body fluids

or

(b) a gas element which forms a gas in contact with body fluids,

or both as an indicator

with

(c) at least one hygiene article component,

to form a hygiene article.

8. An absorbent hygiene article obtainable by a process as per claim 7.

9. The use of an absorbent hygiene article according to any of claims 1 to 6 or 8 to assist the toilet training of children aged from 0.5 to 5 years.

10. The use of

(α) a stiffening element which stiffens in contact with body fluids

or of

(β) a gas element which forms a gas in contact with body fluids,

or both

in a hygiene article to control a wearer's inclination to urinate as a urination indicator.